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The American Biology Teacher

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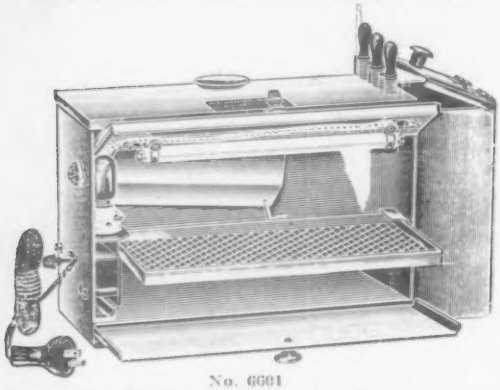

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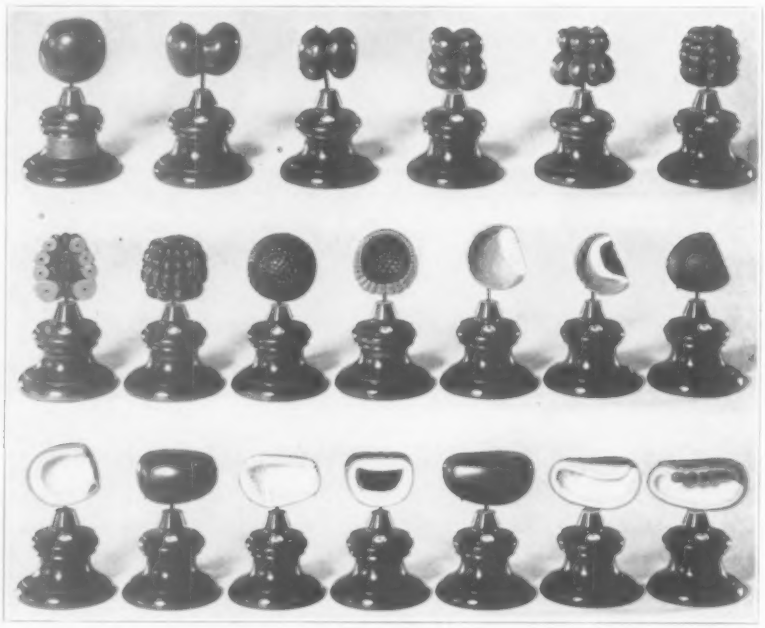

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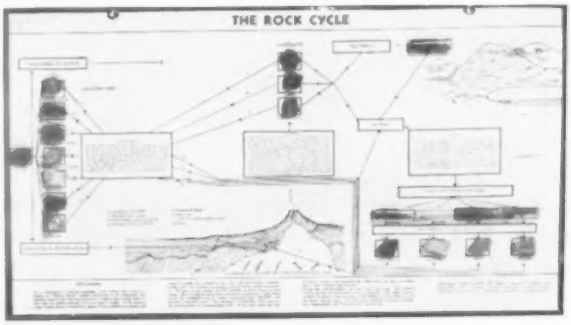

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The American Biology Teacher

Vol. 3 MAY, 1941 No. 8

The Training of Biology Teachers: Data from a Questionnaire

FREDERICK L. FITZPATRICK
Professor of Natural Sciences, Teachers College, Columbia University, New York

This is a report upon the formal training of secondary school biology teachers, as set forth in replies to the questionnaire circulated by the Committee on the Teaching of Biological Science, of the Union of American Biological Societies, in 1939–1940. Some of the findings have already been outlined by Dr. Oscar Riddle[1] in an earlier statement. The figures hereinafter cited represent a total of 3,186 teachers,[2] but in interpreting the data, it must be remembered that not *all* individuals responded to every item. This fact accounts for various apparent discrepancies which appear. Moreover, it should be made clear that there is some duplication among figures, because certain classification categories overlap.

[1] Riddle, Oscar. "Preliminary Impressions and Facts from a Questionnaire on Secondary School Biology." *The American Biology Teacher*, Vol. 3, No. 5, pp. 151–159, February, 1941.

[2] All data analyzed and summarized by Leona Lewis Riddle. Several breakdowns were made, figures being totaled for large cities, small cities, towns, and rural schools, and also according to a classification into public, private, and parochial schools. There was further analysis in terms of geographical areas; *i.e.*, New England, Central States, etc.

Science Courses in Teacher Training Programs

Of the 3,186 individuals, 1,685 indicated that they had received baccalaureate degrees only, 1,311 the M.S. or M.A. degree, and 48 a doctorate.[3] Only 142 teachers failed to claim at least a B.A. degree, or its equivalent. This may represent mere oversight on the part of some, but probably means that most members of this group did not in fact possess such academic honors. Be that as it may, it is clear that very few teachers of secondary school biology have not completed a four year college course. Moreover, 42.4% stated that they had

[3] The degrees specified included M.D., Sc.D., and Ph.D.

one year of graduate school experience, 20.9% two years, and 11.4% had been in such advanced schools for three or more years. This probably should be regarded as a reasonably good showing,[4] but it is pertinent to inquire about more specific details of the training represented.

Out of the entire group, 1,533 testified that they had prepared to teach biology, and had majored in this subject while in college, and 933 designated biology as a minor. Aside from these, 702 had special training to teach other sciences, 141 to teach social studies, and 535 to give instruction in a wide variety of non-science subjects. In addition, 618 individuals noted specifically that they *had not* prepared to teach biology. The latter three figures total 1,294, but there is considerable duplication among them. The data seem to indicate that from 700 to 1,000, or somewhat less than a third of the entire group, did not have special training to teach biology. Probably this situation is no more unsatisfactory than in the case of other secondary school subjects. The circumstance is also mitigated by the fact that many of those not specially prepared in advance to teach biology have had *some* biological training as undergraduates, and have taken additional courses in graduate years. It seems evident that the average teacher has quite a sense of professional obligation, and, given opportunity, will attempt to secure training in excess of minimum legal requirements.

The average number of college credits (all teachers) in *biological* science proved to be 37.1. For public school teachers alone, the corresponding figure was 37.6; for teachers in parochial schools it was 30.1, and for teachers in non-parochial private schools it was 33.8. There were, moreover, some interesting regional differences, as shown in Table 1. An examination of the figures therein will reveal that public school biology teachers of towns and rural centers have had less college training in biology than has been enjoyed by teachers in larger population centers. It also develops that the average number of college credits in biology is highest for teachers in the western and central areas[5] and lowest for teachers in New England.

The fact that teachers in rural schools and towns have generally had fewer courses in biology as preparation for

TABLE 1*

College credit in biological science reported by teachers in classified public schools (semester hours)

Section	Large cities	Small cities	Towns	Rural	Total public
New England	57.2	26.0	23.8	19.6	29.7
Mid. Atlantic	43.9	40.2	32.7	28.3	35.7
Southern	41.9	41.2	32.2	27.4	32.4
Central	48.9	49.4	37.5	30.7	38.7
Western	44.7	59.0	42.5	36.5	42.5

* Table by Leona Lewis Riddle.

[4] Figures for all senior high school teachers (Evenden, E. S., and others. *National Survey of the Education of Teachers: Teacher Personnel in the United States*, pp. 46–47. United States Department of the Interior, Bulletin 1933, No. 10, Washington, D. C., 1935) show that 85% hold the B.A. degree, and that 15.5% possess master's degrees.

[5] Regions represented in this, and similar statements, are as follows:

New England: Maine, Massachusetts, Vermont, New Hampshire, Connecticut, Rhode Island.

Middle Atlantic: New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, West Virginia, Washington, D. C.

Central: Ohio, Michigan, Indiana, Illinois, Kentucky, Wisconsin, Iowa, Minnesota, Missouri, Nebraska, Kansas, North Dakota, South Dakota.

Southern: North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Louisiana, Mississippi, Arkansas, Oklahoma, Texas.

Western: Colorado, Wyoming, New Mexico, Arizona, Montana, Utah, Idaho, Nevada, Washington, Oregon, California.

teaching the materials of this science may be partially explained on several grounds. No doubt a very important factor is that individuals in these less populous localities frequently have to teach four or more subjects, and not a few of them have prepared for their professional labors with this prospect in mind. It is also in these smaller centers that the new and less experienced teachers are most likely to be appointed. Many of them are comparatively new graduates, who have recently met the requirements for certification, and have not added post-graduate courses in biology to their totals. As to the figures for the New England area, it may be observed that despite the low general average, teachers in large cities report the highest average total of biological training indicated in Table 1. The general average is pulled down by the extremely low figure representative of rural communities.

(formal training) comparable to that of the teachers in large city systems. The records from the western region are particularly surprising, in that figures representing small cities, towns, and rural schools are relatively high. Table 2 carries a comparison of formal science training experienced by public school, parochial school, and private school teachers. The lowest total is that of the individuals who work in parochial schools, but the figure for private school teachers is not very much higher.

When one attempts to interpret the whole picture, as portrayed in Tables 1 and 2, several meaningful factors must be kept in mind. One has been mentioned already: the fact that many secondary school instructors must be prepared in three or four subjects to meet existing demands of employment. Another is that opportunities for specialized training in undergraduate programs are limited by several pressures.[6] It should

TABLE 2

College credits in science reported by biology teachers

	Total biology credits (semester hours)	Percentage biology in undergraduate program*	Percentage other science in undergraduate program	Percentage biology in graduate program	Percentage other science in graduate program
Public school teachers (2900)	37.6	27.6	24.8	41.4	13.9
Parochial school teachers (99)	30.1	25.6	22.3	43.9	21.7
Private school teachers (184)	33.8	22.1	25.3	36.1	25.8

* As compared with non-biological courses in undergraduate training.

Other comparisons from Table 1 suggest that, except for the New England area, biology teachers who work in small cities have a subject matter background

also be realized that the figures in Table 1 do not include courses in allied sciences, such as chemistry, geology, psychology, and physics, some or all of which are

[6] These pressures include the so-called basic courses which colleges require for graduation, and also various educational courses stipulated by laws for certification. The tendency in recent years undoubtedly has been to broaden the base of undergraduate experience, rather than to encourage specialization. On the other hand, a parallel trend has been to insist upon at least a five-year training course, and the additional year might reasonably be expected to provide for more adequate contact with the subject matter.

likely to be a part of training programs as shown by data in Table 2. In the light of all these considerations, the record does not appear to be exceptionally bad, and it approximates what might be regarded as a desirable standard in the western part of the country.

Actually, the figures on undergraduate programs show that the ratio of biological courses to those in other sciences (all teachers) was 27.5% as compared with 24.7%. The corresponding percentage of courses in educational theory and methods was 20.3. The sum of these figures is 72.5%, and presumably the remaining quarter of undergraduate work was distributed among electives, and specific requirements for graduation.

A further and more general interpretation is that our main reliance for more extended study of biological subject matter on the part of secondary school teachers must rest with the graduate years. For this reason, the data submitted on graduate work loom as something especially significant. For all biology teachers the percentage of biological courses in this phase of experience was 41.2; for other sciences it was 14.7; for professional education courses it was 32.6. At first thought, this may seem to be a rather inequitable distribution of emphasis, but such a conclusion should be embraced with caution, for again it is apparent that various influences tend to affect the result. These are so important that some analysis of the situation will be attempted.

Despite the growth of teachers colleges, many of our secondary school teachers continue to be recruited from the graduating classes of liberal arts colleges. In the experience of the writer, these prospective teachers often have not planned teaching careers, and find themselves minus required education courses when they make their belated decisions. They thereupon remain in college for a fifth year, taking courses in education for the most part, and to a lesser extent supplementing the subject matter training that they may already possess. It can be added, likewise from first-hand experience and observation, that graduates of teacher-training institutions often present an antithetic case; they are likely to be well-fortified with education courses before they invade the post-baccalaureate realm, and correspondingly less conversant with basic science. They ordinarily may be expected to supplement their familiarity with subject matter without further delay, although in some cases the opportunity clearly is not exploited.

It is also a matter of record that quite a goodly proportion of so-called education courses taken by science teachers involve considerable study of science subject matter. Thus, a course in the "teaching of science," or the "teaching of biology" may be largely professionalized science material,[7] even though it is labeled "educational." Such a prospect is likely to appeal to the teacher who deals with several science subjects, and must divide time and energy among them.[8]

Nevertheless, credit for the work goes into the record as pedagogy rather than science. That the teachers of cities have better opportunity to concentrate upon the study of a single field is amply at-

[7] Other courses bearing such titles appear to be largely concerned with the theories of education in relationship to science teaching. There clearly is no standard of practice.

[8] A recent study (Gentry, A. N. "A Survey of Biology Teaching in Kansas High Schools." *Trans. Kansas Acad. Sci.*, Vol. 43, p. 358, 1940) shows that only 14% of teachers responding (102) teach nothing but biology. A complete analysis of this matter, taking up the case of secondary school teachers in general, will be found in Evenden, E. S., and others, *op. cit.*, chapter IV.

tested by the figures. In Michigan, for instance, graduate training of large-city teachers included 56.2% of courses in biology, and the small-city teachers were close behind with 53.5%. On the other hand, those serving towns and rural districts reported only 16.6% and 10.0% of such work in their graduate programs. Even more startling is the fact that 15% of the public school teachers reporting on the nature of graduate courses testified that none from the field of biology was included. To assert that the last two statements represent an undesirable state of affairs is to put the matter mildly, but it must be recognized that the real problem in the situation springs from the fact that instructors in small schools generally have to present a variety of subjects; commonly including those outside the field of science.

What Teachers Think About Training Programs

The foregoing considerations undoubtedly color another response to the question as to whether it was thought that teacher training should include more or less of professional education courses. The judgment proved to be reasonably close; 1,294 suggesting more, and 1,138 favoring less. In putting this proposition before the teachers, no distinction was made between general or basic courses (*i.e.*, history of education, educational psychology, and philosophy of education), and the special methods courses (*i.e.*, teaching of science, teaching of biology, and practice teaching). One may suspect that a considerably different expression of sentiment would have been evidenced if this had been done. In fact, some of the spontaneous suggestions classified in Table 3 strongly support such an inference.

On another point, however, the testimony approached unanimity. This was with respect to the general desirability of having more or less of subject matter courses in teacher-training programs. Of the 2,325 individuals who filled in this item, 2,138 said more. Here there is indication that biology teachers themselves recognize certain subject-matter inadequacies, a proposition that should certainly be given grave future consideration.

Before leaving this topic, a related matter should be brought to attention. When one examines the college records of biology teachers, it is easy enough to understand why many of them would recommend more extensive training in the subject matter of their science. It is not, however, purely a matter of more subject matter per se; rather, it is only too obvious that some biology courses make a valuable contribution, and others do not.[9] Staff members of teachers colleges are wont to say that specialized courses in the academic departments of liberal arts colleges are designed for the training of research workers rather than teachers. The individuals under fire come back with the rejoinder that teacher training courses are superficial, and that they bespeak no real mastery of the subject matter. No doubt the truth of the matter is that plenty of examples can be brought forth to support both contentions, but that neither charge is universally true. What is needed is a pooling of theoretical and factual resources, and latterly there is encouraging evidence of progress in that direction. We also need to recognize more clearly that teaching is an exacting profession; that the time has passed when any sort of general course may be deemed adequate for the teacher's purposes.

[9] Largely because the content and emphasis have little relationship to the materials of secondary school biology.

This brings us quite naturally to another group of teacher responses that are partially summarized in Table 3. One item of the questionnaire called for suggestions regarding training courses, without giving any leads as to what these might be. Not all individuals made response, as might be expected, and those who did covered a very wide range of things. When the replies from eight states[10] were analyzed as a sample, however, certain attestations recurred with sufficient frequency to attract attention and study. These are listed in the table; many others, that were supported by only a few persons, have been omitted because of sheer space limitations. It should be admitted that the objectivity of these data are open to some question, because it was difficult to interpret some of the statements.

Certain things do seem to emerge, however, and they indicate a very real concern about existing subject matter and methods courses. Both were freely criticized, directly and by implication, on the general ground that they did not provide the pre-service teacher with needed skills and information. The responses suggest that many people from widely separated parts of the country really gave thought to their training in terms of teaching problems, and that in making free response achieved some measure of agreement. That they were able to do this is rather impressive to the writer, and their depositions seem correspondingly worthy of careful consideration. Perhaps there is something in the previously cited contention that many methods and many content courses fail to prepare the teacher adequately. After all, if anyone would know, it should be those who took them, and then went out to encounter actual classroom experiences.

TABLE 3

Criticisms of teacher training expressed by public school biology teachers of eight states in rank order. (Only the more commonly mentioned items included)

Rank order	Large city	Small city	Town	Rural	Net rank (unweighted)
More special methods courses of truly practical nature	5	1	1	2	1
Better training in laboratory and demonstration techniques	4	1	3	2	2
More, and better, practice teaching (and observation)	1	5	2	5	3
More introductory courses in related science	2	3	5	6	4
More field work	2	4	6	4	4
Practical, applied, or functional phases stressed in biology courses	6	6	4	1	6
Less specialized training in biology	9	7	7	7	7
Less professional education	7	8	8	10	8
Less of theoretical courses in education	7	10	9	8	9
More general culture courses	10	9	10	8	10

Let us go on from this to more specific analysis of the grounds upon which methods courses came in for special mention, not failing to note that more was

[10] Alabama, California, Colorado, Massachusetts, Minnesota, New York, Ohio, and Texas.

said about them than about any other single topic. First of all, quite a few commentators applauded good methods courses, and practically all of those offering criticisms did so in constructive manner, and with the implied assumption that the offering could be useful if properly planned and executed. Numerous teachers seemed to feel, however, that many current offerings are left in charge of college instructors who are more or less unfamiliar with school situations. Others believe that such presentations are too much on the theoretical side, and largely devoid of practical application. They expressed considerable enthusiasm for a knowledge of procedure and technique, rather than an extended dose of theory and generality.

Allied to the methods courses are those in supervised observation and/or practice teaching. A glance at Table 3 will show that many who reacted to this item favored development and extension of practice teaching experiences. There also was prominent mention of the need for more laboratory and demonstration training, and for greater familiarity with the use of visual aids. Some statements of this latter type clearly anticipated that the work would be part and parcel of methodology; others were referring to a different matter—the occasional scarcity of laboratory offerings in content courses,[11] and the consequent failure of the teacher to become versed in certain facts, techniques, and skills.

The principal objection to existing subject matter courses (biology) was that many of them were not "practical," or "functional" in terms of the teacher's professional needs. Careful analysis of testimony gives evidence that the witnesses had two or three related things in mind. Some of them stated that most content courses in their training programs had been too highly specialized along one or another line to be of much value as background for secondary school instruction. Others noted that the trend toward consideration of biological applications to human affairs, so evident in present-day high school instruction, is not paralleled in training courses. It can also be seen (Table 3) that a good many individuals asked for a broader grounding in the separate biological sciences, and less of a tendency to specialize in one sub-science. Field work was mentioned again and again as something that had been neglected. Specific reference was also accorded to genetics, ecology, and work with conservation problems. The tendency to take introductory courses in allied sciences, and particularly geology, chemistry, psychology (mental hygiene), agriculture, physics, and anthropology was commended.

To one who has made more than casual study of the problems just mentioned, these reactions are not surprising. For example, the Sub-committee on Teacher Education of the National Committee on Science Teaching has recently completed a survey of in-service teacher opinion. One question asked was:[12] "Are the present fields of specialization commonly chosen by science teachers the most appropriate for their work?" Only 13% said yes, 36% were uncertain, and 51% said no. Replies to other questions in this survey brought out the point now frequently made that content courses for secondary school science teachers must not only supply basic facts and principles, but must concentrate upon those that apply to the problems of modern life, and show how and why such rela-

[11] A goodly number of general, or survey-type, courses do not include laboratory work.

[12] *The Education of the Teaching Scientist* (S. R. Powers, Chm.). Rept. Subcomm. on Teacher Education, Natnl. Comm. Sci. Tchng. p. IV–3, February, 1941.

tionships exist.

A fairly large proportion of teachers called for less required education. In this case the storm centers of objection were the "general" courses,[13] rather than those dealing with methods. The former were censured on the ground that they made little or no contribution to what the teacher must know in order to function successfully, and that they tended to be unduly theoretical and repetitive. A few individuals signified an interest in philosophic studies, but they were greatly outvoted by their fellows. There was, however, a larger group that called for broader training in all fields, in addition to the sciences.

The relative importance assigned to various training problems by teachers in large and small schools may be discerned by examining figures in Table 3. Additional differences not indicated therein included the fact that various town and rural school teachers mentioned the need for training in agriculture, and how to teach biology when supplies and equipment are meager.

Summary

When one contemplates the data in their entirety, and the inferences that may be drawn from them, several noteworthy things emerge with respect to teachers of secondary school biology in the United States, and what they think about the training they received after they have gone out in the field and have had actual teaching experience. The important points seem to be as follows:

1. Two-thirds of the teachers were "trained" to give instruction in biology, and most of them hold either the B.A., or a Master's degree, or both.

2. The average secondary school teacher has had about 37 semester hours of instruction in biology courses, including those taken on both graduate and undergraduate levels. Parochial school teachers, private school teachers, and those serving towns and rural communities tend to fall below this average.

3. The average teacher has had a fairly broad training in sciences, and responses indicate that the teachers approve this state of affairs.

4. The teachers want more subject matter courses in their training programs, but with the proviso that they be "functional"; that the content be selected with the needs of secondary school instruction in mind, and that they be relatively unspecialized.

5. The teachers suggest a need for better special methods courses, meanwhile criticizing some of those now in existence. More specifically, they desire
   (a) Improved training in laboratory and demonstration techniques.
   (b) Courses in observation and practice teaching that really function.
   (c) Training in techniques adapted to schools having little equipment and material.

6. The teachers tend to condemn professional education courses that are largely devoted to theoretical considerations.

[13] An extended analysis of professional attitudes toward general courses in education, and special methods courses will be found in Rugg, E. U., and others, *National Survey of the Education of Teachers: Teacher Education Curricula*, Chapt. VI, United States Department of the Interior, Bulletin 1933, No. 10, Washington, D. C., 1935.

Buildings, Equipment and Textbooks Used by Teachers of Biology in Secondary Schools: Data From A Questionnaire

DR. EDMUND W. SINNOTT
Professor of Botany, Yale University, New Haven, Connecticut

Second only to the training and ability of the biological teacher, is the character of the facilities and equipment provided for his teaching. An analysis of replies from the questionnaire proposed by the Committee appointed by the Union of American Biological Societies shows that in very many schools these leave a great deal to be desired, and that, as in other aspects of our problem, there are marked differences between various regions and between schools in large and in small communities.

Accredited Schools

The great majority (97.3%) of the high schools in which biology is taught are accredited. There is little regional difference in this respect, but city schools have an advantage over others in that 99% of them are accredited as against 96.85% in towns and 95.5% in rural communities. In parochial schools the percentage is 96%, as against 97.7% for private schools.

Building

The condition of the building leaves more to be desired. In the cities nearly four-fifths of the schools are well housed but this is less true in smaller communities, as is shown in Table 1. In rural schools, only 62% of the buildings are reported as good, 29.3% as fair and 8.7% as poor, surely an unsatisfactory situation but doubtlessly reflecting the generally lower economic level of the country communities.

Table 1
Condition of building

	Good	Fair	Poor
	%	%	%
Cities	79.0	17.2	3.7
Towns	71.0	24.6	4.4
Rural	62.0	29.3	8.7
Total	71.5	23.4	5.3

Regional differences are also marked, as shown in Table 2.

Table 2
Condition of building

	Good	Fair	Poor
	%	%	%
New England	69.5	23.4	6.8
Middle Atl.	69.8	24.4	5.9
Southern	60.7	33.0	6.4
Central	72.3	21.8	5.9
Western	75.1	22.4	2.6

The west is distinctly better than the rest of the country, with only 2.6% poor. The south is on the whole the worst, though the percentage of poor

schools is actually highest in New England. New England cities, however, reach the highest percentage of "good" in the country (82.3) as against 81.7 in the west. Only 1.4% of the western cities report "poor" buildings, as against 2.2 in New England. In communities smaller than cities, New England is worst (49.3% good, 36.9% fair, 13.9% poor) with the south not much better (55.6%, 37.6%, 6.9%) and Central, Middle Atlantic and Western improving in that order. Indeed, town and rural school buildings in the West are not very far behind the cities in New England.

Of parochial school buildings, 67.8% are reported as good, 30.2% as fair and 2.1% as poor but private schools are considerably better, with 80.3%, 16.4% and 3.4%, respectively.

Rooms

Rooms are provided especially for biological teaching in about two-thirds of all schools, but here again conditions are rather diverse. Our questionnaire asked whether biology was taught in such a special room, in a room with no special provisions, or in a room especially equipped for other subjects. The general results are shown in Table 3.

Table 3

Character of room

	Specially equipped	Not equipped	Otherwise equipped
	%	%	%
Cities	80.5	14.4	5.0
Towns	66.0	21.5	12.3
Rural	54.2	30.0	15.7
Total	69.0	20.8	10.3

Obviously the rural and town schools are considerably handicapped in comparison to those of the cities in this respect. Regional differences are also considerable, as shown in Table 4.

Table 4

Character of room

	Specially equipped	Not equipped	Otherwise equipped
	%	%	%
New England	56.8	34.3	8.9
Middle Atl.	68.3	22.4	9.4
Southern	69.4	20.6	10.0
Central	69.2	19.7	11.2
Western	73.4	17.3	9.4

The percentage of schools with special rooms rise steadily from New England to the West, though the number obliged to use rooms otherwise equipped is not greatly different in the various regions.

In this respect conditions in parochial and private schools are much better than in public schools, percentages in the former being 80.3, 14.6 and 5.2, and in the latter 78.7, 12.4 and 9.2.

Equipment

The equipment of the biology room is in general far from satisfactory as is shown by Table 5. To reduce the answers to the questionnaire to simple terms, equipment was now classified as "good," "fair" and "poor."

Table 5

Equipment

	Good	Fair	Poor
	%	%	%
Cities	63.8	26.2	9.9
Towns	32.8	36.3	30.8
Rural	13.2	25.0	61.7
Total	39.4	28.2	32.4

For the country as a whole about one-third of the schools report good equipment, one-third fair and one-third poor.

The differences here are much more marked, however, than in the case of building and room. Even in the cities

less than two-thirds of the schools reported good equipment, though in the largest cities this figure rises to 73.5%. In town schools conditions are even more unfavorable and in rural schools there is the shocking situation where only 13% have good equipment and over 61% poor. Nowhere else is the difference between schools in large and small communities so great.

There are significant regional differences, too, in biological equipment, as shown in Table 6.

Table 6
Equipment

	Good	Fair	Poor
	%	%	%
New England	44.3	26.4	29.3
Middle Atlantic	46.8	30.9	22.4
Southern	27.0	26.2	46.7
Central	36.0	26.4	37.7
Western	41.2	29.9	28.9

New England, Middle Atlantic and the West are above the national average and the Southern and Central states below. An analysis by community size, however, shows that this relationship is not characteristic of all schools. In city schools, the Middle Atlantic states have the highest proportion of good equipment and lowest of poor, with the Central states, New England, the West and the South following in that order. In country schools (town and rural) however, the West with 28.6% good, 28.6% fair and 42.8% poor; and the Middle Atlantic states with 24.1%, 39.0% and 36.9% are best; the Central states are next with 20.4%, 27.3% and 52.3%; the South next with 14.5%, 27.1% and 58.5%, and New England definitely the worst, with 9.4% good, 28.1% fair and 62.5% poor. In rural schools alone, the picture is a little different, the West having 16% good, 25.2% fair and 58.8% poor; the Central states 15.5%, 23.2%, and 61.3%; the Middle Atlantic states 13.1%, 36.5% and 50.4%; New England 10.7%, 17.8% and 71.4%; and the South 8.5%, 20.3% and 71.3%. The number of "rural" schools reporting in New England, however, was only 28, so that the figures for this region are probably not very trustworthy. Certainly schools in small communities are not as well equipped biologically in New England and the South as they are in the rest of the country, badly off as that is.

Parochial school equipment is not far from the average for the country, with 40.3% good, 32.0% fair and 27.8% poor. Private schools, however, are distinctly better than the average, with 58.3% good, 25.0% fair and 16.7% poor. This is definitely below the level of public schools in the cities, however.

Field Trips

Rural and town schools make up somewhat for their poorer equipment by using field trips more generally as a means of biological instruction, as is shown by Table 7.

Table 7
Field trips

	Taking field trips	Not taking field trips
	%	%
Cities	48.8	51.3
Town	76.5	23.5
Rural	79.5	20.5
Total	57.5	42.5

In the large cities, only 40.5% of the schools had field trips and in the largest only 35%. The number of trips taken was considerable, averaging over six per year for these schools which report taking field trips.

Field trips, as might be expected, are used most commonly in the South, where 83.1% of the schools take them, as compared with 74.2% in the Central states,

60.5% in the Western, 51.0% in New England and 48.8% in the Middle Atlantic states. The highest percentage, 90.3%, is found in town schools of the South and the lowest, 23.8% in the city schools of the Middle Atlantic states. These figures are presented in Table 8.

Table 8

Percentage of schools taking field trips

	Total	Rural	Towns	Cities
	%	%	%	%
New England	51.0	84.7	63.2	36.0
Middle Atl.	48.8	78.0	63.0	23.8
Southern	83.0	85.8	90.3	71.0
Central	74.2	80.0	81.3	60.5
Western	60.5	70.3	70.2	43.8

About three-fourths of both the private and the parochial schools report taking field trips, a figure about like that of town public schools. The average number of trips, however, is only 4.6 for parochial schools as against 7.2 for private schools.

Biological Books

Practically all schools reporting (98.5%) have some sort of a biological library, but its size is in indirect proportion to the size of the community. The average number of books in rural school libraries is 36, in towns, 60, and in cities 150. There are also considerable regional differences. Here again New England with an average library of 61 books and the South with one of 67.5 are behind the rest of the country. The figure for the Middle Atlantic states is 107, for the West, 100, and for the Central states 96.5.

The average number for parochial schools is 71 and for private schools 100.

Text-books

About three-fourths of the schools report that their text-book is satisfactory and the differences between schools in large and in small communities and in various regions are not great. For the country as a whole, 74.0% report satisfactory texts, for rural schools 74.7%; for town, 78.5%; and for cities 67.7%. In New England 78.0% are satisfactory; in the Middle Atlantic states 73.0%; in the South 73.0%; in the Central states 72.0 and in the West 75.0%. There seems to be a definitely lower degree of satisfaction in the cities. This is emphasized by the fact that 74.0% of the small cities report satisfactory texts, 61.5% of the large ones, but only 57.0% of the largest cities. Either the larger communities were unfortunate in their selection of texts or their teachers are more critical.

Of parochial schools 84.4% report satisfactory texts and of private schools 80.0%, both considerably above the national average.

Method of Choosing Texts

Much of the dissatisfaction with the text doubtless arises from the manner in which text-books are selected. Our questionnaire asks which of nine methods are used: choice by city board of education, county board, state board, committee of biology teachers, the principal, a curriculum committee, the superintendent, the biology teacher himself, or another teacher. Table 9 shows the distribution of these methods.

It is evident that in rural schools the superintendent and the state board have a much larger share in the choice than they do elsewhere and that, naturally, the city boards are important factors in larger communities. In small cities, however, only about 3.5% of the schools reported texts chosen by the city board, as contrasted with 25.0% in large cities and 33.6% in the largest ones. In cities, too, a committee of biologists makes the choice in nearly a third of the cases re-

ported. The individual teacher has much more to say about the choice of his text in town and country than in the city, a fact which may explain the greater dissatisfaction of city biology teachers with the texts they use.

Table 9

Method of selecting texts

	Total	Rural	Town	City
	%	%	%	%
City Board	5.8	1.5	1.9	13.3
County Board	2.5	5.5	2.0	0.5
State Board	10.8	17.0	11.0	7.6
Committee of biologists	14.6	4.5	5.2	32.2
Principal	8.6	8.3	10.0	7.6
Curriculum committee	3.7	2.5	2.2	6.2
Superintendent	10.0	15.9	12.0	4.9
Teacher himself	30.4	29.7	40.0	18.4
Another teacher	13.4	15.0	15.5	9.4

Certain regional differences also appear, as is shown in Table 10.

Table 10

Method of selecting texts

	N.E.	Mid. Atl.	So.	Cent.	West
	%	%	%	%	%
City board	4.1	8.7	3.5	6.4	5.1
County board	0.0	3.0	2.8	3.1	0.7
State board	0.0	4.0	51.4	8.7	5.8
Committee of biologists	17.0	17.3	10.8	16.3	20.8
Principal	8.3	11.4	2.1	9.2	6.2
Curriculum committee	3.1	3.7	9.2	2.6	4.6
Superintendent	9.3	5.9	5.2	14.1	8.6
Teacher himself	38.6	33.4	10.6	26.4	31.6
Another teacher	19.6	12.7	4.5	13.1	16.6

The chief point of difference which these figures bring out is the dominance of the state boards of education in the South, where more than half the schools have their texts chosen by this means. Choices by committees of biology teachers and by individual teacher are therefore much less common in the South than elsewhere.

In the parochial schools reporting, the principal is more important in this respect than in other schools, choosing the text in over 15.0% of the cases. Otherwise the parochial figures are much like those of public schools.

In private schools, on the contrary, the individual teacher has much greater freedom of choice, since he selects his own texts in 66.0% of the schools reporting. Another teacher does so in 14.4% and the principal in 9.3%.

Conclusions

The facts as set forth here need little further comment. Evidently equipment and conditions for work are far less satisfactory, the country over, than could be desired. Schools in cities, and particularly in the large cities, with their stronger financial support, are better off than in towns, and very much better than those in rural districts. It should be remembered, however, that country schools are in a much more favorable position to teach biology directly than are city schools and that their pupils have a better general knowledge of living things from their own experience outside the class-room than do pupils in city schools, so that partial compensation is thus possible for poorer equipment.

Regional differences are evidently important, too. It is to be expected that the South, especially the rural South, with its less favorable economic position, should have relatively poor equipment and facilities. There is again some compensation here because of the more favorable climatic conditions for first-hand study of living things.

It is somewhat surprising that rural New England should be so far behind most other parts of the country in bio-

logical facilities in its schools; but this is probably related to the fact that in most of them biology is not taught as a distinct subject.

THE BIOLOGY CLUB

One is faced with many problems as the leader of a club. Two important ones are how to arouse an interest in the club, and how to urge members to participate in and to carry to a conclusion a worthwhile activity.

Interest in a club may be stimulated in various ways. The following are a few that have been tried:

1. Signs, announcing club meetings, printed in attractive colors, catch the eye much better than chalk notices. So that these signs do not become permanent unnoticed fixtures it is best to arrange for the appearance of a series of differently colored ones in each room. All this is done by the "announcement committee."

2. Since students are usually interested in what their classmates are doing, the biology bulletin board should be used to display the work of club members. Hall display cases should be used to exhibit projects completed by club members. Each exhibit should be set up by the student who completed it. Thus the pupil is given an opportunity to show the results of his endeavors, and other pupils may be encouraged to do a similar piece of work. The projects exhibited should be on such a level that other students feel they can and would like to engage in the activity or a similar one. The arrangement and timeliness of both bulletin board and display cases are cared for by the "display committee."

3. The school paper can be an excellent means for arousing interest in a club. Announcements written by the club's press agent are usually more enticing than the cut and dried ones written by the school's club reporter. A science section edited by members of the science clubs should be a part of every school paper.

4. A pep talk by each teacher at the beginning of the term is very helpful. This is especially so when it is immediately followed by distributing application blanks, and having the students sign them before their enthusiasm wanes. Whenever possible, the teacher should tie up class work with club work. The results of club projects should be used in class. Problems set in class can be solved by experiments carried on during club periods.

5. Once each year a school science fair can be held. All pupils should be encouraged to exhibit. The best exhibits can then be sent to the "Science Fair of the American Institute."

6. The best way of arousing interest in a club is to have interesting and worthwhile meetings. "Somehow or other the news gets around" and other students will wish to join.

Interest in worthwhile pupil activities is maintained as follows:

1. Have members with similar interests work together. In order to do this have each new member list the following information on a library card:

Name Age
Address Progress Grade
1. Sciences studied:—
2. Do you own a microscope?— A camera?—
3. List three activities you would like to engage in as a member of this club.

With this information the "steering committee" groups individuals having similar interests.

2. There are as many groups in the club as there are individuals with common interests. Each group is under the leadership of a chairman, who usually is an older and more experienced club

member. He acts as guide and coordinator. At the end of each meeting, the chairman decides what materials his group will need for the next meeting. He gives this list of materials to the club's secretary.

3. The agenda for each meeting is arranged for by the "steering committee." Usually the meeting consists of:

a. Roll call.

b. A short talk or demonstration by a member or outside speaker.

c. Committee reports.

d. The club divides into groups to carry on project work.

4. The members of the all important "steering committee" are the chairmen of the various groups. This committee assigns new members to their project groups; coordinates the work of the various committees; compiles a composite requisition slip listing the materials needed for the next meeting; makes arrangements for field trips, guest speakers, etc.

In clubs conducted on the above plan, each member works with others having similar interests, and is under the guidance of a student leader who understands his needs and problems. He usually carries his job to a conclusion because he is in competition with others doing the same type of work or in cooperation with students to finish a planned project. He realizes that eventually he will demonstrate before the club or a science class. Furthermore, he has the satisfaction of seeing his work displayed in the display case or reported in the school paper. Not only does the student learn to cooperate with others, but he eventually will become a group leader and learn to lead. The aim of the teacher should be to so arrange conditions and groups that each member learns to cooperate and lead with as little adult guidance as possible. Eventually there should be complete independence from adult supervision.

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SPECIAL ISSUES FOR NEXT FALL

Plans are well under way for the publication next school year of a series of *Special Issues.* The Associate Editors whose names are listed below are acting as chairmen of committees, under the general coordination of Mr. Russell, in the assembling of material to be used in the following Special Issues:

Nature Study, Ruth A. Dodge
Field Trips, Lee R. Yothers
Health and Hygiene, Brother H. Charles
Biology Clubs, Philip E. Foss
Consumer Biology, Melvin A. Hintz
Visual Aids, W. A. Betts
Conservation, Willis W. Collins

These topics were among those most frequently mentioned in the returns from a questionnaire sent to members last year. If you have a favorite project, unit, method, or teaching device under any of the items listed above and would like to share it with others, please write it up and send your manuscript to the chairman of the committee concerned. Manuscripts should be typed, double-spaced, on $8\frac{1}{2} \times 11$ paper. Drawings and photographs which you desire included should be sent with the manuscript. We are not able to guarantee publication of all articles received, but so far as space permits those having the widest appeal will be selected. Other factors being equal, short papers have a better chance of being published than long ones; lengthy introductions in particular should be avoided.

E. C. C.

President's Page

INSIDE STUFF AND "AU REVOIR"

Recently I found myself seated at a banquet next to a well-known educator who was not a member of our organization. When I mentioned the fact that I was associated with *The National Association of Biology Teachers*, he remarked, "Oh! That is the group that is underwritten by the Carnegie People, is it not?" The remark startled me, more from its unexpectedness than because it was entirely inaccurate. It may be that some of our own members have been similarly misled, so I am going to tell the "Inside Story."

The Union of American Biological Societies obtained a grant from the Carnegie Foundation for the express purpose of promoting the biological sciences. As one of several methods for achieving this objective, the Union conceived the idea of an organization, national in scope, devoted to the teaching of the life sciences in the schools. Accordingly, Carnegie money was used in initiating and promoting the proposed venture, even to the extent of defraying a portion, but not all, of the expenses of fifteen delegates from nine states[1] to New York in July, 1938. However, once the framework of the organization was laid out, no further funds were forthcoming. I shall never forget the "let-down" feeling that came over me toward the end of the second day of organization. We had worked day and night in a crowded hotel room, had written a Constitution, had elected officers and had laid out plans for a journal. Next we began to consider ways and means of securing members. Naïvely we turned to Doctor Oscar Riddle for funds, only to be told gently, but firmly, that now that we were organized we must go on from here—alone. I am afraid that if some of us had been aware of this beforehand it is questionable if we had come to New York in the first place.

Here we were with a national organization on our hands; we even had a monthly magazine, at least on paper. But we did not have a dollar in the treasury. 'Tis true there were several hundred names that could be contacted, and the Union through Doctor Riddle and Dr. D. F. Miller has continued to show a friendly, even a paternal, interest in the venture. Nevertheless, it can be said that *The National Association of Biology Teachers* was started on a shoestring—and faith, or ignorance as you prefer.

From the very first we have never been underwritten, and yet we were determined to keep the price down to a dollar a year. Best of all, from the first we have managed to operate without a deficit.

You can readily see that someone has had to put in a lot of hard work, and that none of the officers has been able to get rich out of it. The first executive board paid its own expenses to the annual meeting and had one hundred per cent attendance. Not yet are we in a position to pay full traveling expenses, much less board and room, of the officers to and from meetings. No one connected with the Association or the Journal has received any salary.

When I go out of office on July first there will remain only one of the original group that met in New York in 1938 as

[1] For names and addresses of the delegates, see THE AMERICAN BIOLOGY TEACHER, Vol. 1, No. 1, October, 1938.

a member of the official family. That sole remaining member of the original group will be our unmatched secretary, Mr. Houdek, and I dread to think of the coming of the day, and come it must, when he also will step out. That, too, is a fixed policy of the N. A. B. T.: the preservation of a democratic organization controlled by no clique. Gradually the old hands withdraw in favor of new. The future of the whole venture rests and always will rest upon the membership as a whole.

As president I have had a lot of fun this year, and I can truthfully say that I have genuinely enjoyed the work. I liked the people that I have had to work with. Mistakes I have made, to be sure, but the mistakes have not been intentionally made. Enemies I have not made for the very simple reason that the crowd that run the N. A. B. T. can give and take. I turn over the presidency to Homer Stephens with confidence. After every contact with Homer my opinion of him has risen. His enthusiasm and ability have been proven, and I bespeak for him a very successful administration. He and the members of his staff merit your continued support.

SUMMER MEETING OF NATIONAL ASSOCIATION

Plans have been made for a one-day Summer Meeting of *The National Association of Biology Teachers* on June 25, 1941, in the historic town of Durham, N. H. (home of the University of New Hampshire), in connection with the summer meeting of the A.A.A.S.

There will be sessions both morning and afternoon, with a luncheon at noon. An interesting program is assured. For details write to Dr. C. F. Jackson, Head of the Biology Department of the University of New Hampshire, who is in charge of local arrangements.

OFFICERS FOR 1941-1942

The newly-elected officers of *The National Association of Biology Teachers* for the year beginning July 1, 1941, are as follows:

President, Homer A. Stephens, Ingalls Junior-Senior High School, Atchison, Kansas (chosen President-elect in 1940; automatically becoming President in 1941).

President-elect, M. A. Russell, Junior High School, Highland Park, Michigan.

First Vice President, W. A. Betts, Austin High School, Austin, Texas.

Second Vice President, Ruth A. Dodge, Johnstown High School, Johnstown, New York.

Secretary-Treasurer, P. K. Houdek, Township High School, Robinson, Illinois.

The results of the recent election as shown above have just been announced by Mr. Malcolm D. Campbell, Dorchester High School for Boys, Boston, Massachusetts, who served as chairman of the Canvassing Committee.

Biographical sketches of the successful candidates were published in the February issue of THE AMERICAN BIOLOGY TEACHER; all of the new officers have been active workers in the Association and can be counted upon to serve faithfully the cause in which we are all interested—the promotion of better biology teaching. On behalf of the members of the Association we extend sincere congratulations and best wishes to the new officers. There is every reason to hope that during the coming year our organization will continue the same steady and healthy growth which it has shown in the first three years of its life.

We are certain also that you favor extending a hearty vote of thanks to our retiring officers for the efficient manner in which they have conducted the business of the Association—often at considerable personal sacrifice in time and money—during the past year.

E. C. C.

The Milkweed Bug as a Live Laboratory Animal

WM. P. HAYES
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In the last few years certain entomologists have been rearing the milkweed bug in large numbers for testing the killing power of certain insecticides. Because of the facility with which this insect can be reared and maintained throughout the year and the considerable numbers that can be produced, it seems that this insect would make a desirable addition to the live animal collection of any biological laboratory. As an example of an insect life history with gradual metamorphosis, it makes a striking contrast to the insects usually reared that have a complete metamorphosis. Another factor suggesting the use of this species for rearing is the fact that it occurs throughout most of the United States and is one of the most widely distributed Hemiptera in the Western Hemisphere.

This insect (see figure) is a large black and red bug belonging to the family Lygaeidae in the order Hemiptera ("True-bugs"). Its scientific name is *Oncopeltus fasciatus* (Dallas). Because of its superficial resemblance to the common box-elder bug, it is frequently mistaken for that insect. Both are red and black but the milkweed bug is larger and may be distinguished by the fact that it does not have the three reddish longitudinal stripes on the upper surface of the prothorax which are present on the box elder bug and by its having a broad, black band across the middle of the wings when they are held at rest.

As the common name "milkweed bug" indicates, this species feeds on and is to be found around numerous species of milkweed. They are usually to be found around the flowers and pods. In the latitude of Illinois and Iowa the young nymphs may be first found in the field during the last week of July and are present until frost. In warmer climates the bugs hibernate as adults. Cultures in the class room may be maintained indefinitely as it apparently is not necessary for these insects to hibernate.

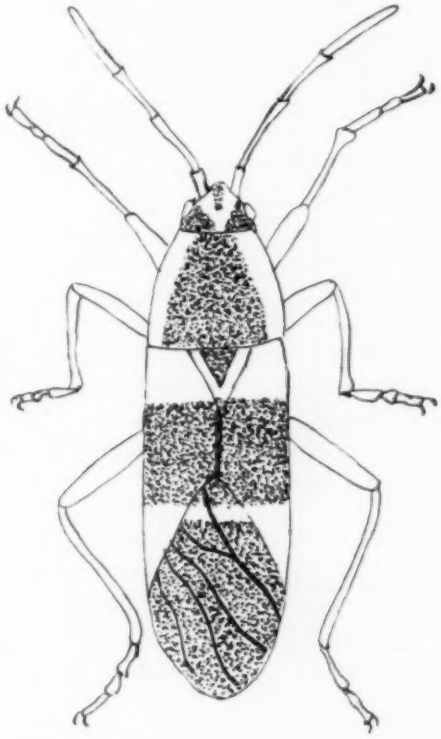
A large lamp chimney, glass battery jar or an old glass aquarium covered with a piece of cheesecloth will serve as a rearing cage and one of two types of food may be used: either growing milkweed plants or dried milkweed seeds. They seem to thrive best on the dried seeds if supplied with a vial of water which is stoppered with a cotton plug through which they push their beak to drink. Besides the vial of water and dried seeds the only other thing needed is a medium-sized wad of cotton in which the bugs lay their eggs.

The eggs are usually inserted by the females some distance into the cotton. They are oval with a cap at the anterior end which is surrounded by 11 to 13 fairly prominent chorial processes. When freshly laid the eggs are yellowish and soon change to red. The embryo may be seen through the chorion (shell) near the end of development. The eggs are easily discernible in the cotton and may be hatched in this mass of cotton or removed to other cages. The length of the egg stage is from three to six days depending on the temperature. Hatching is accomplished by pushing off the

cap of the chorion. From 10 to 25 minutes are required for emergence from the shell.

Soon after hatching the young nymphs start out in search of food. As soon as a milkweed plant, a pod or a seed is found, the nymphs insert their beak and feed for several minutes. The dried pods or seeds can be their sole diet and they will thrive if provided with a vial of water. The water seems necessary to supplement the meager liquids which they extract from the seeds. The nymphs molt five times before becoming adult and require an average of 30 days to reach the adult stage after hatching. The adults live under normal conditions from 39 to 48 days. The pre-mating period is from six to eight days and the period after mating before eggs are laid is from four to eight days. The females, after finding a wad of cotton, lay from 2 to 38 eggs deeply into the cotton. Considerable variation occurs in the total number of eggs laid. The range in numbers laid by a single individual has been observed to be from as few as five eggs to as many as 1238 eggs. From the foregoing figures, it is apparent that one generation from egg to egg can be produced in slightly over one month. Factors that shorten or prolong these periods seem to be temperature and moisture. Gravid females will fail to lay eggs unless a piece of cotton or fuzzy milkweed pod is placed in the cage.

Since these insects breed rapidly and can be maintained as live cultures throughout the year they serve as excellent material for demonstrating such interesting things as gradual metamorphosis, oviposition, and molting. Comparative growth rates can be noted by growing and comparing species reared on dried seeds and on living milkweed plants. It has been demonstrated that individuals grown on dried seeds mature on the average about 3 days earlier than those reared on living milkweed plants.



Milkweed Bug—Adult. Colors: black and yellow or black and red.

A phenomenon of special interest and not observed in the rearing of silkworms and other caterpillars is the external development of wings in the nymphs. The first two instars are without traces of wing pads but after the second molt (third instar) wing pads appear as swellings on the posterior edge of the metathorax. The anterior (mesothoracic) wings appear in the fourth instar and nearly cover the wings of the metathorax. In this instar the two scent glands are quite apparent on the upper side of the third and fourth abdominal segments. These glands are functional during nymphal life and are replaced in the adult by a single pair of glands

found on the underside of the thorax, between the bases of the middle and hind pair of legs, where they may be recognized as raised oval-structures, reddish or yellowish in color and with a single transverse slit in the middle. The piercing-sucking type mouth parts are easily discernible. This type functions much like a soda straw thrust into a soft drink.

The following brief description of the adult should make this insect distinguishable from related forms:

Length: 13–18 mm., elongate oval. Color black and red, with the sides of the head and edges of the pronotum red or yellowish. The wings have a broad transverse black band about midway between the scutellum and the membrane which is also black. In front of and behind the black transverse band the wings are red or yellow.

Only a few bugs and a small amount of milkweed seed are needed to start a colony and within the course of a single term or semester two or more generations may be obtained. Seeds may be gathered at any time and stored in any containers available. The dryness of the seed apparently has no effect on the development of these insects and only a few seeds scattered over the floor of the cage will support a considerable number of these bugs. In large cultures of these insects, for the sake of cleanliness, it is well to place a piece of paper in the bottom of the cage on which the seeds and cotton may be placed. This can be removed when contaminated. Cultures of this insect have been maintained in laboratories at the University of Illinois for as long as three years without having to be replenished.

The so-called "false milkweed bug" (*Lygaeus kalmii*) has been reared in a similar manner but it is not as useful since it must undergo a long diapause. The box elder bug (*Leptocoris trivittatus*) can likewise be raised on box elder seeds but with much more difficulty.

From Aquarium to Waste Basket in 42 Minutes

HELEN WHITTIER
Gardner High School, Gardner, Massachusetts

Like many another biology teacher I must have reflected to myself a score of times, "it really is a pity they don't get a chance to do any dissection," meaning that the difficulty of a class period of only 42 minutes was simply insurmountable, and that with our present set-up there was no chance for a double period.

Because there seemed to be disappointment among some students due to the omission of the frog classic, I tried having a class for dissection of the frog in the afternoon. By the third year this group had grown to be so large that it seemed about as practical to do the work in the regular class period. Therefore I undertook the experiment of engineering a dissection period of 42 minutes, and to my surprise it has turned out pretty well. So here it is, for anyone who is interested in single period trouble.

The day before the event all directions are given, and the importance of the time element and clockwork precision of the program are explained. The class has already recited on the internal structure

of the frog, examined large museum specimens of dissected bullfrogs, charts, and an indispensable large colored model of a dissected specimen. Accordingly on the appointed day the procedure runs off like this.

As soon as the students enter the room (2 or 3 minutes are saved in this way) they line up cafeteria style for the articles needed. Each one interested puts paper towels and a dissecting set under his arm and is handed a struggling frog which a helper has taken from the aquarium and over the head of which I have clapped a folded square of cloth saturated with chloroform. He goes to his desk to spread out the towels and to wait until the animal is ready, which it is understood to be only when entirely flexible. Keep the square of cloth and chloroform handy in case it stiffens at all. (Beware the antivivisectionists who may be peering about.)

Fifteen or twenty frogs can thus be anaesthetized in 5 minutes, and 8 minutes after the ringing of the last bell they are ready for work.

There will usually be a half dozen students in a class of 30 who want no part in this activity. They retire to a corner to do home work. No costly frogs wasted on them. Fortunately the rooms in our building seat no more than 30 students.

Since time is of the essence, there is no drawing or writing. Just cut and look. Dissecting pans are only in the way.

At the warning bell, amphibian remains are cleared into the wastebaskets, desks cleaned off, instruments washed and replaced in cases. This is a madhouse for a few minutes but it can't be helped if one is to be ready for the next period, unless you have one of those new laboratory rooms with a sink every few feet. A few specimens are wrapped in paper towels and marked to go into the school kitchen refrigerator for further work some afternoon. (Make friends with the ladies of the kitchen before you try this.) Now and then a specimen is saved to delight the home folks.

The following day finishes up the job, when certain questions are answered in the workbook, and a home work paper is passed in, entitled, "Interesting things I noticed while working on the dissection."

And now, gentle reader, I am aware that what one wants to know is, does all this bother pay any dividends, and just what does a student get out of anything done in such a rush?

My aims for the day's work (and am I glad when it is over) are listed below.

In the 30 minutes of actual investigation the student should have time to recognize and observe:

1. The dilation of the capillaries in the skin, its thinness and looseness.
2. The lung structure with its capillaries, and sometimes the lung inflation.
3. The thin mesentery.
4. The organs of the viscera.
5. The large number of eggs (always surprise at this).
6. The green bile from the gall bladder.
7. The tendons in the hind legs.
8. Tongue, glottis, Eustachian tubes.
9. Lens of the eye.
10. Most important of all, the chambers of the heart in operation. The heart is removed and put into salt water, where it may beat from 10 to 40 minutes. Use a concentration of 0.7 gram of sodium chloride to 90 cc. distilled water.

Maybe it would be too much to claim that like Pascal when he first took his barometer to a mountain top, my young friends are "ravished with admiration and astonishment" by the wonders of science, still, that heart beating in the saline solution gives them a certain feeling of kinship with Alexis Carrel, and once in a while some one tackles the volume "Man the Unknown" just to prove he is one of the intelligentsia.

Yes, it would save a lot of trouble to

use preserved frogs. But high school students hate the smell of formaldehyde, and I myself prefer H_2S. And who can think of anything farther and with greater finality removed from the study of life processes than those mortuary objects?

One last word. If sometime you elect to run through this program for four or five periods between eight and one o'clock, be sure you get your sleep the night before.

Thomas Henry Huxley as a Biologist

JAMES D. TELLER
The Ohio State University

To the majority of people the name of Thomas Henry Huxley is associated with evolution and monkeys. Even Carlyle on meeting Huxley on a street in London showed his displeasure with the theory of evolution by remarking "You're Huxley, aren't you? the man that says we are all descended from monkeys."[1] To fewer people, more open-minded than the first class, the name Huxley brings vivid recollections of exciting controversial battles by the "bull-dog of Darwin." To still fewer people Huxley is suggestive of an eminent scientist, a biologist in his own right. And it is with the opinions of this small minority that we shall be primarily concerned in this brief treatise.

While it is true that Huxley was the lieutenant of the organizer of the Darwinian Revolution; while it is a fact that this revolution in thought exerted an influence comparable only with that of the Copernican Revolution; while it is conceded that "lieutenant" Huxley was a master of the controversial art and a popularizer of no mean ability; nevertheless, we must recognize that all of the foregoing momentous achievements would have been largely impossible if Huxley had not been he whom Haeckel has called "the first English zoologist."

[1] Ayres, Clarence, *Huxley*, p. 21, New York, W. W. Norton and Company, 1932.

Perhaps, before proceeding to a discussion of the research that led such an eminent German zoologist as Haeckel to characterize Huxley as above, it may be profitable to show in what fields his observations were concentrated. To do this we must go back to the days when Huxley was yet a student in Charing Cross School of Medicine.[2] Here he became extremely interested in physiology, possibly due to the influence of Mr. Wharton Jones, lecturer on physiology at the school, possibly to an earlier desire to be a mechanical engineer which now found expression in the "mechanical engineering of living machines,"[3] probably to both influences. Thus, Huxley's interests early centered in that major field of biology denominated zoology and in that particular division of zoology known as physiology. An appointment to H. M. S. "Rattlesnake" on a voyage of exploration to Australasia[4] gave Huxley opportunity to pursue zoological studies. But a later appointment as a lecturer on natural history in the School of Mines in London diverted his atten-

[2] Cf. Huxley, Leonard, *Life and Letters of Thomas Henry Huxley*, Vol. I, pp. 21–23, New York, D. Appleton Company, 1901.

[3] Cf. Huxley, Thomas Henry, *Collected Essays*, Vol. I, pp. 6–7, New York, D. Appleton Co., 1897.

[4] Cf. Huxley, Leonard, *op. cit.*, Vol. I, pp. 28–30.

tion to paleontology. This study he found extremely valuable when he elaborated on the views of Darwin and traced their implications for man. This work entitles Huxley to a place as one of the founders of the sciences of ethnology and of anthropology. In short then, we may place Huxley's endeavors in the field of zoology.

From the preceding paragraph, the reader must have suspected that we shall have to deal only briefly and with the major contributions of Huxley's half century of observation and generalization in zoology. For from the time of the publication of Huxley's first scientific paper in the "Medical Gazette" of 1845 until his death in 1895, we find him always with more than one iron in the fire. This first paper was based on a discovery of Huxley while yet a student under Jones. At the early age of nineteen he had discovered a previously unobserved membrane in the root of the human hair still known as "Huxley's Layer."[5]

During the voyage of the "Rattlesnake" we find Huxley submitting various monographs on his observations. One of these, "On the Anatomy and Affinities of the Family of the Medusae" was a prophetic utterance of the part he was destined to play in zoology from that time on. His methods of zoological study were clearly different from those of his predecessors. Instead of stating matters of detail concerning particular genera and species, he aimed at "giving broad and general views of the whole class, considered as organized upon a given type, and inquiring into its relations with other families."[6] In this particular instance Huxley wished "to lay particular stress upon the composition of this (the stomach) and other organs of the Medusae out of two distinct membranes," as he believed "that it is one of the essential peculiarities of their structure, and that a knowledge of the fact is of great importance in investigating their homologies." He called "these two membranes as such, and independently of any modifications into particular organs, 'foundation membranes'" thus emphasizing "that a medusa consists essentially of two membranes inclosing a variously shaped cavity, inasmuch as its various organs are so composed."[7] Through these generalizations Professor Kowalevsky considers that Huxley "founded modern embryology by demonstrating the homology of the germinal layers of vertebrates with the ectoderm and endoderm of coelenterates."[8]

While a lecturer in the school of mines, Huxley concerned himself with problems of zoological classification. The type classification founded by Cuvier and fostered by Agassiz in America in which the animal kingdom was divided into four great divisions (vertebrates, mollusks, articulates, and radiates) was segregated by Huxley into two great divisions (protozoa and metazoa). This division, while not exactly original with Huxley, was aided in its acceptance by the recognition given by Huxley.[9] In addition to this achievement Huxley aided the classification of the Ganoid Fishes[10] and of the Vertebrates.[11] Further he disturbed the classifications accepted by ornithology and set ornithologists to further investigation.[12]

While carrying on his observations which led to these revisions in classifica-

[5] *Ibid.*, p. 23.

[6] *Ibid.*, p. 42.

[7] *Ibid.*, p. 43.

[8] *Nature*, p. 651, Oct. 31, 1895.

[9] Gill, Theodore, "Huxley and His Work," *Smithsonian Reports*, p. 767, 1895.

[10] *Ibid.*, p. 770.

[11] *Ibid.*, p. 773.

[12] *Ibid.*, p. 774.

tion, Huxley also enountered his arch-antagonist, Sir Richard Owen, the dean of British scientists of the time. In these controversies Huxley's interpretations finally prevailed. He showed that Owen's hypothesis of the existence in the brain of man of three structures ("posterior lobe," "posterior cornu" and "hippocampus minor") peculiar to the brain of man only was contradictory to the facts. Huxley demonstrated the existence of these structures in all the anthropoid apes. Even before this triumph Huxley had overthrown Owen's vertebrate theory of the skull by showing that the "relation of the skull to the spinal column is quite different from that of one part of the vertebral column to another."[13]

Such in its main outlines is a part of Huxley's contributions to zoology. His work as a missionary of Darwin is too well known to need further comment. His essays are masterpieces of English literature. One commentator describes Huxley as having "a gift for the apt and acid phrase which reverberates after weaker words are forgotten." Indeed, this same biographer believes that Huxley "remains a considerable force because he happened to be a literary genius, as well as a biologist."[14] Another biographer echoes the same thought when he refers to Huxley's treatise on the "Crayfish" as "perhaps the most perfect zoological treatise ever published."[15] But Huxley was even more than a scientist, more than a literary genius—as if these were not sufficient—he was an outstanding teacher. As such he has been regarded as "the father of modern laboratory instruction."[16] His influence on the teaching of biology has left its mark on most of our institutions of learning and many members of their faculties. The author of a frequent reference in the course of elementary zoology in many American universities was a student under Huxley and was sent to Johns Hopkins University on Huxley's recommendation.[17] This inspiring influence on students is one of Huxley's chief claims to fame as a great teacher.

Books

WERKMEISTER, W. H. *A Philosophy of Science.* Harper & Brothers, New York. 551 pp. 1940. $4.00.

This book is the substance of a course in the philosophy of science given by the author at the University of Nebraska. Most of it is devoted to a review of the major generalizations in the various branches of science from the viewpoint of their philosophical implications. An attempt is made at integration under a unified point of view. It is not possible to present in brief compass a full account of the philosophical position that is reached. The following quotations may, however, give a clue.

"All knowledge is grounded in first-person experience and . . . there can

[13] *Ibid.*, p. 769.

[14] Peterson, Houston, *Huxley, Prophet of Science*, p. vii, New York, Longmans, Green and Co., 1932.

[15] Ayres, Clarence, *op. cit.*, p. 134.

[16] *Ibid.*, p. 155.

[17] H. N. Martin served as an assistant in the laboratory at South Kensington under Huxley. When President Gilman of Johns Hopkins University was looking for the first incumbent of the chair of biology at that university, he consulted Huxley who recommended Martin. While at Johns Hopkins, Martin wrote the text referred to, *The Human Body.*

be no knowledge which is not concerned with 'objects' of first person experience or with objects connected with this experience in definitely definable ways. . . . That of which 'I' am aware—the entire range of perceptions, thoughts, illusions, feelings, urges, and volitions—is the 'content' of experience. . . . The integration of the contents of experience is possible only through the use of concepts. But concepts could not serve as means of integration, if they themselves were but 'copies' of the things they signify. . . . They are principles or rules by means of which the given complexities of perceptions, remembrances, anticipations, and imaginings are integrated into the coherent unity of specific objects which are 'stable' and 'continuous' and as rules or 'principles of integration' the concepts are, furthermore, indispensable conditions of objectivity."

The author discusses or criticizes at length the various points of view toward the mind-body problems—interaction, parallelism, materialism, spiritualism, the double aspect theory, etc. He sums up his own attitude in the statement, "There is then no escape from the conclusion that both body and mind as complementary aspects are necessary for the interpretation of a reality which transcends the integrating power of either one. And this reality, I believe, is what may legitimately be called personality." This appears to be a form of the double aspect theory, under which the world is primarily a mental manifold consisting of innumerable, partially independent foci of awareness and volition, whose substrates for stimulus and action are the other such foci, a viewpoint under which each focus necessarily presents a dual aspect—subject and object. Each as subject integrates the ever-shifting array of impressions received from the others, perhaps always in an interpretive framework of time and space and acts on the basis of this integration. But under this viewpoint all "objects" in so far as they behave as "wholes"—electrons, atoms, molecules, genes and cells, as well as organisms, must have this double aspect. The author, however, seems to draw a sharp line between the objects of the physical sciences and those of the biological sciences.

The book begins with an illuminating discussion of the origin of modern scientific method. The author here emphasizes the self-denying ordinance deliberately accepted by Galileo, Newton and others, according to which science should restrict itself to the organization of knowledge of phenomena (*i.e.*, regularities in the minds of human observers) and especially to the quantitative aspects (as the element in human minds on which closest agreement is possible). Science must accordingly dismiss from its scope all unverifiable speculation on the essences back of the phenomena and on ultimate causes. Its characteristic method—the hypothetico-deductive procedure—is neither purely empirical nor purely rational. It is empirical, but is concerned with ordering of facts rather than with the accumulation of disconnected observations. It is rational but not interested in chains of logic which do not lead to possibilities of empirical verification.

The success of science has led many to forget its self-imposed restriction and to interpret its concepts as "copies of reality," leading to a philosophically untenable materialism. The author shows at considerable length how the more recent concepts in the physical sciences—general relativity, wave mechanics, etc., have led away from such a view. It has become almost painfully obvious that the

most general concepts are merely rules for integrating experience.

The least satisfactory part of the book to the reviewer was that dealing with life. Here the author deliberately abandons the method of science. While granting that organisms are subject to principles of physics and chemistry, he denies the possibility of any scientific interpretation of the self-regulatory processes. He would have the interpretation of ontogeny essentially begin and end with the statement that the organism is a "whole." Chromosomes and genes are mentioned briefly but only to deprecate their significance. The current conception of their relations to characters is not stated correctly ("each gene is a definitely preformed and fixed determiner of some specific character of the mature individual"). It would represent the views of geneticists for at least the last quarter of a century more correctly to say that each gene is a self-perpetuating entity which, as a component of cells, and through these of organisms, is a stable factor in an epigenetically developing system. There is, indeed, no discussion of the hierarchic organization of living beings, the recognition of which (in the cell theory and the gene theory) have been among the most fruitful "integrating concepts" attained by biologists.

Equally unsatisfactory is the treatment of evolution. After expressing a leaning toward the Lamarckian theory (without appreciating that it is logically associated with preformation, of which he does not approve), the author vigorously rejects natural selection (although this is compatible with epigenesis of which he approves). Seven objections to natural selection are listed as insurmountable. This is not the place for a detailed discussion but I think that few geneticists, at least, would accept any of them as valid objections. As with ontogeny, the Mendelian principles of heredity are dismissed as of negligible importance. After a very brief discussion along these lines (4 pages) the author turns to a relatively detailed account (10 pages) of philosophic speculation as an allegedly preferable *alternative*. This treatment contrasts with that in the discussion of physical sciences, in which the objective generalizations as to the regularities of phenomena are accepted as integrating concepts, however much they may require philosophical interpretation as a *supplement*. The possibility of philosophic interpretation of the pressures of mutation, hybridization and natural selection, and of the effects of isolation on populations, as wholes, is not considered.

Biologists, as well as other scientists, will find much that is stimulating in this book. Experimental biologists, however, can hardly accept its philosophic point of view without bringing to a premature end their task of integrating experience in an important field. The crudest form of materialism seems preferable as a working philosophy since this is practically merely an identification of the necessary limitations of science with all of reality. The reviewer prefers a dual aspect point of view with much in common with that of the author, but applied consistently to the behavior of all "objects" and thus constituting a really unified point of view. In this there need be no limit in the integration of the concepts of "wholes" with suitably extended concepts of "parts" as far as statistical regularities in observed behavior are concerned. The uniqueness of all individual events, and of course the internal aspect for the entities them-

selves, necessarily escape the method of science.

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Protozoa in Biological Research. Edited by GARY N. CALKINS and FRANCIS M. SUMMERS. Columbia University Press, New York. xli + 1148 pp. 226 Figs., 4 Plates. 1941. $10.00.

In the present volume the editors disclaim any intention of presenting a textbook for the study of the Protozoa; the aim is rather to give a summary of the present state of knowledge regarding this group of animals and to point out the problems which require additional investigation with respect to the group.

Each chapter is the product of a specialist writing on the phase of protozoölogy in which he is best known. The chapter headings and their authors are as follows:

General Considerations, *by Gary N. Calkins;* Some Physical Properties of the Protoplasm of the Protozoa, *by H. W. Beams and R. L. King;* Cytoplasmic Inclusions, *by Ronald F. MacLennan;* Fibrillar Systems in Ciliates, *by C. V. Taylor;* Motor Response in Unicellular Animals, *by S. O. Mast;* Respiratory Metabolism, *by Theodore Louis Jahn;* The Contractile Vacuole, *by J. H. Weatherby;* The Technique and Significance of Control in Protozoan Culture, *by George W. Kidder;* Food Requirements and Other Factors Influencing Growth of Protozoa in Pure Culture, *by R. P. Hall;* The Growth of Protozoa, *by Oscar W. Richards;* The Life Cycle of the Protozoa, *by Charles Atwood Kofoid;* Fertilization in Protozoa, *by John P. Turner;* Endomixis, *by Lorande Loss Woodruff;* Sexuality in Unicellular Organisms, *by T. M. Sonneborn;* Inheritance in Protozoa, *by H. S. Jennings;* The Protozoa in Connection with Morphogenetic Problems, *by Francis M. Summers;* Certain Aspects of Pathogenicity of Protozoa, *by Elery R. Becker;* The Immunology of the Parasitic Protozoa, *by William H. Taliaferro;* Relationships between Certain Protozoa and Other Animals, *by Harold Kirby, Jr.;* Organisms Living on and in Protozoa, *by Harold Kirby, Jr.*

The chapters vary greatly in length, ranging from 12 pages for chapter XVII to 119 pages for chapter XIX. Each is a unit in itself, with its own appended literature list. The citations are unusually extensive. The text figures are numbered consecutively throughout the book and there is a single author-subject index covering 34 pages. As indicated by the table of contents, the principles of morphology, physiology, reproduction, heredity, and interrelationships are well covered. The question of the origin and evolution of the Protozoa is not covered specifically although the old problem of the relation of the Protozoa to the Metazoa and the question of the cellularity of the Protozoa are discussed incidentally in some of the chapters. The extreme views of Dobell and others who have denied the cellular nature of the Protozoa are not adopted.

Many interesting general facts and principles are discussed which are omitted entirely from the ordinary textbooks in zoölogy: to illustrate, numerous examples are cited of Protozoa serving as hosts to a great variety of other organisms. In some cases the parasitic organism actually invades the nucleus of the protozoon: certain bacteria are found living within the micronuclei as well as within the macronuclei of ciliates. Reasons are advanced for the wisdom of returning to the original usage of the

term *symbiosis* as employed by its originator, A. de Bary (1879), to include commensalism, mutualism, and parasitism.

In a work written by as large a number of authors as the present one some overlapping and repetition are inevitable. The reader benefits, however, from the variety of points of view and from the thoroughness of treatment which could not be expected from a single author.

The make-up of the book shows careful editing. The figures are very well executed and the 11-point type on good weight, non-glare paper makes for easy legibility. The printing and binding are of the excellent quality which one has learned to expect from the Columbia University Press.

As a reference work for the zoölogist and the biologist in general, this book is highly recommended. It should be made available in every library and laboratory where a serious study of the Protozoa is attempted. E. C. C.

Biological Symposia: A Series of Volumes Devoted to Current Symposia in the Field of Biology. Edited by JAQUES CATTELL. Vol. II. The Jaques Cattell Press, Lancaster, Pa. 270 pp. 1941. $2.50.

Frequently in recent years scientists have been accused of allowing themselves to become narrow specialists—mere fact gatherers who do not know how to interpret their facts. The holding of symposia on basic problems, as exemplified by the series of papers published in this volume should go far to refute such accusations. Most of the papers are short and are not too technical for those who are untrained in the special field covered by the paper. Each article is a unit in itself, written by a scientist who has done original work in the field; many of the contributors are recognized as authorities in their respective fields.

There are four symposia in the book here reviewed:

I. *Symposium on Speciation.*

Introduction. Leon J. Cole.
Speciation of Fishes. Carl L. Hubbs.
Ecologic and Genetic Variability within Species of Peromyscus. Lee R. Dice.
Speciation from the Point of View of Genetics. M. R. Irwin and R. W. Cumley.
Breeding Structure of Populations in Relation to Speciation. Sewall Wright.
Speciation Phenomena in Birds. Ernst Mayr.
Speciation in Peromyscus. Lee R. Dice.
Levels of Divergence in Drosophila Speciation. Warren P. Spencer.
Speciation as a Stage in Evolutionary Divergence. Th. Dobzhansky.

II. *Symposium on the Defense Mechanisms in Plants and Animals.*

Local Reactions in Plants. F. W. Went.
Generalized Defense Reactions in Plants. W. C. Price.
Local and Generalized Defense Reactions in Animals. William Bloom.

III. *Symposium on the Biological Basis of Social Problems.*

Introduction. S. J. Holmes.
A Few Words about Nature. Wm. E. Ritter.
Social Integration as a Biological Process. C. M. Child.
The Naturalist as a Social Phenomenon. Francis B. Sumner.
The Ethics of Enmity in Social Evolution. S. J. Holmes.
A Biologist's Appreciation of Religion

as a Factor in Social Evolution. E. B. Copeland.

IV. *Symposium on Regeneration.*

Introduction. J. William Buchanan.
The Histologic Basis of Regeneration and Reassociation in Lower Invertebrates. W. C. Curtis.
The Environmental Control of Regeneration in Euplanaria. Olin Roulon.
Aspects of Regeneration in Annelids. Libbie H. Hyman.
Contributions to the Problem of Regeneration in Protozoa. William Balamuth.

Each paper concludes with a selected list of references, largely recent titles. The volume as a whole is made up of excellent material, interestingly presented, of value to the teacher of general biology as well as to the specialist who wishes an authoritative yet brief summary of knowledge on the broad biological problems covered in the symposia.

The book is printed on an excellent grade of non-glare paper in a very clear and legible type. The binding is substantial and attractive. E. C. C.

HANNUM, CLAIR A. *Comparative Chordate Anatomy: A Laboratory Text.* Stanford University Press. vii + 222 pp. 1940. $2.00.

The first sixty-five pages present textual material organized into three units: Chapter I. The Chordates, Chapter II. Phyletic Origins, Chapter III. Ontogenesis. The next one hundred and thirty-three pages contain laboratory directions for the following forms: *Balanoglossus*, a simple ascidian, *Amphioxus*, fresh-water lamprey, shark, *Necturus*, turtle, pigeon, and the rat. There are no diagrams accompanying the laboratory directions. There is a fairly complete index.

The textual material is well chosen and excellently presented. The manual part of the book is organized on the "type study" plan. The aim seems to be to provide only enough information about the organ systems to develop a general understanding of the plan of organization of the various chordate types. The directions are clearly stated and the information is accurate.

The title of the book may suggest to some teachers of Comparative Anatomy that many phylogenetic interpretations accompany the laboratory directions, but this is not the case.

JOHN P. WESSEL,
Wright City, Junior College,
Chicago, Illinois.

CLARK, JOHN A., FITZPATRICK, FREDERICK L., and SMITH, EDITH L. *Science on the March.* Houghton Mifflin Co., Boston. xiv + 585 pp. 1941. $1.72.

Many attempts have been made to develop "scientific attitudes" by adapting conventional texts to new teaching methods. Success seldom results. But here, in *Science on the March*, the authors, taking ample advantage of a young person's natural curiosity, have organized their material in such a way that scientific thinking and attitudes have a better chance to develop than "parrot" methods and fact collection. It is this organization which is the book's outstanding feature.

One hundred four problems in general science, stated in provocative question form, are grouped under inclusive chapter headings. Several related chapters form larger units under titles of Air, Water, Food, Reproduction, Health, Sun Energy, Universe, Weather, Natural Resources, Communication, and Transportation. Each chapter is organized as follows: (1) The problem-question (four

in each chapter); (2) Demonstration or experiment for observation; (3) Interesting, simply-worded discussion of the best obtainable data on the subject; and (4) Questions and suggested activities to elicit objective conclusions. Each large unit is systematically summarized, and tests, readings, and pertinent motion pictures are included. Photographs, line drawings, and diagrams are used profusely, and fully half are titled in question form. The subject index is adequate, and an index of experiments and demonstrations is a convenient addition.

This book is flexible enough to enrich conventional courses already established, or to serve as the basic text in newly organized ones. The authors' preface grades it in the ninth year, but it will be equally valuable in any high school general science. It goes seriously and in a mature way about its business and asks the "learner to depend not upon the word of authority alone—he is encouraged to find his own answers."

Helen Connon,
David Starr Jordan Junior High School, Palto Alto, California.

Vance, B. B., Barker, C. A., and Miller, D. F. *Biology Workbook.* J. B. Lippincott Co., Chicago. iv + 317 pp. 1941. $.92.

This new workbook in biology is designed for use with any standard high school biology textbook and will fit most courses of study in biology. It has features which will appeal to the high school boy and girl, especially the average high school student. The book is divided into thirteen units which are subdivided into unit-problems. Each unit-problem has activities pointing to the practical side of biology, and the problems are so worked out that each can be completed during an average class period. There are optional activities at the end of most of the problems, giving excellent suggestions to those students who have time or special interest in doing more than the minimum work.

At the beginning of each unit there is a page of pictures, which convey to the student the problems to be taken up in the unit. These pictures are very good and well chosen. The diagrams in the book proper are large and accurate. At the end of each unit is a list of the vocabulary for the unit along with a list of "Do You Know"? questions. There are also self tests for the student which help him in checking his mastery of the unit. There is also a series of achievement tests which can be had separately. The list of reference books with specific page references is given for each unit which is a distinct aid to a student who is anxious to get more than one author's point of view or explanation on the particular subject being studied.

Melvin A. Hintz.

RECENT GOVERNMENT BULLETINS

(Note: A weekly list of selected government publications will be sent free on request made to the Superintendent of Documents, Government Printing Office, Washington, D. C.)

"Officials and organizations concerned with wildlife protection." 1940. 17 pp. (Fish and Wildlife Service, Wildlife Circular 10.) 5¢.

"Propagation and distribution of food fishes, fiscal year, 1939." 1940. 44. pp (Commerce Dept., Bureau of Fisheries.) 10¢.

"Disease-resistant varieties of vegetables for the home garden." 1940. 8 pp. (Agriculture Dept., Leaflet 203.) 5¢. Vegetables mentioned are asparagus, beans, cabbage, celery, cucumber, lettuce, muskmelon, potato, pumpkin, spinach, sweet corn, squash, and tomato.

"Culture of Orchids" 1941. 8 pp. il. (Agriculture Dept., Leaflet 206.) 5¢. Gives information relating to propagation, kinds to grow, greenhouse culture, house culture, and disease and insect pests.

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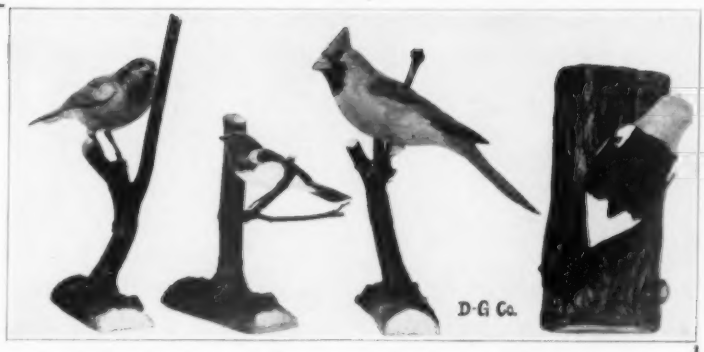

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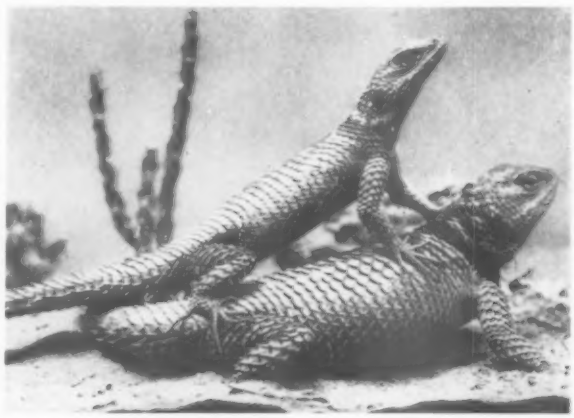

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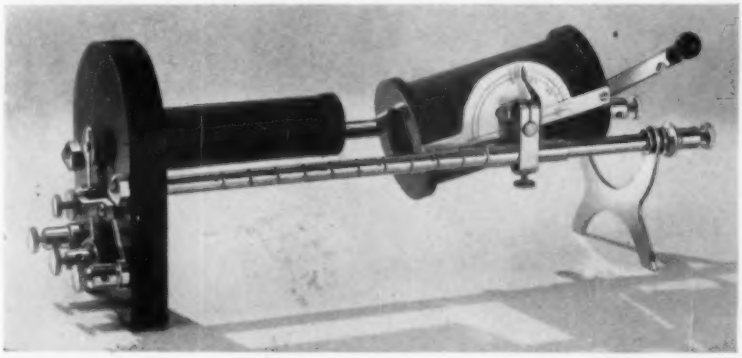

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